Large Area Estimates of Carbon Fluxes of Arctic Landscapes

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OVERVIEW

Net CO_2, evapotranspiration, and energy exchange were measured during the 1994-95 growing seasons (June-August) in moist-acidic (Happy Valley: 69°09'N, 148°51'W), moist non-acidic (24-Mile: 69°56'N, 148°49'W) and wet-sedge tundra ecosystems (U-Pad: 70°17'N, 148°53'W), and during 1998-1999 in wet-moist coastal sedge tundra (Barrow: 71°21'N, 156°37'W) and moist-wet coastal sedge tundra/moist-tussock tundra ecosystems (Atqasuk: 70°28'N, 157°25'W) located on the north slope of Alaska.

METHODS

Site Descriptions

The Happy Valley research site (69°08.54'N, 148°50.47'W) is located 135 km S of the Arctic Ocean and 1.5 km W of the Trans-Alaska Pipeline Haul Road on the North Slope of Alaska. Happy Valley is characteristic of moist-tussock tundra dominated by *Eriophorum vaginatum* L. Inter-tussock microsites are dominated by non-tussock forming sedges (*Carex bigelowii* Torr.), and deciduous and evergreen shrubs (e.g. *Betula nana* L. and *Vaccinium vitis-idaea* L., respectively). Soils are Histic Pergelic Cryaquepts with a 15-30 cm organic layer overlying mineral soil. Mean annual temperature is between -11.1 to -6.7 °C, while mean summer temperature (June-August) is approximately 11 °C. Annual precipitation is on average 345 mm, with 60% falling as rain during the summer months.

The U-Pad and 24-Mile research sites are located on the arctic coastal plain of the North Slope of Alaska. U-Pad (70°16.88'N, 148°53.23'W) is located 10 km south of the Arctic Ocean in the West Operations Area of the Prudhoe Bay oil field, while 24-Mile (69°56.10'N, 148°48.62'W) is located approximately 40 km south of the Arctic Ocean, and 2 km west of the Trans-Alaska Pipeline Haul Road. Vegetation at U-Pad is characteristic of wet- and moist-herbaceous tundra. Wet-herbaceous tundra is common in frequently-inundated drained-lakes, low-centred (concave) polygons, and ice wedges, and is characterized by the herbaceous sedges *Carex aquatilis* Wahlenb. and *Eriophorum scheuchzeri* Hoppe. Moist herbaceous tundra is common in well-drained upland surfaces such as high-centred (convex) polygons, polygon ridges, margins of drained-lakes, and beach ridges, and is dominated by the herbaceous sedges *Carex bigelowii* Torr., and *Eriophorum vaginatum* L. Vegetation at 24-Mile is typical of wet- and moist-herbaceous non-acidic tundra. Soils associated with moist herbaceous tundra are Pergelic-Cryaquolls with relatively deep surface organic layers (> 25 cm) overlying a loamy mineral soil. Soils of wet herbaceous tundra are Histic-Pergelic-Cryaquepts with a surface organic layer of about 40 cm. Mean annual temperature in the Prudhoe Bay region is approximately -13 °C, and average summer temperature (June-August) is 5.5 °C. The U-Pad site is influenced by a maritime climate associated with frequent fog and drizzle, and as a result, ambient temperature near U-Pad is typically 5-10 °C cooler than 24-Mile. Total summer (June-August) precipitation is about 80 mm (30 yr. average, 1961-90).

The Barrow site (71°21'N, 156° 37.31'W) is located adjacent to the National Oceanic & Atmospheric Administration's Climate Monitoring and Diagnostics Laboratory (NOAA-CMDL). The area is composed of several different representative wet-moist coastal sedge tundra types. The Atqasuk site (70°28.18'N, 157°24.54'W) is located 100 km south of Barrow, Alaska, and adjacent to the native village of Atqasuk. Soils are developed on aeolian sands of Quaternary age. The site is comprised of a variety of moist-wet coastal sedge tundra, and moist-tussock tundra surfaces in the more well-drained upland.

Note: These data, as well as flux data from other AmeriFlux sites, are also available via the AmeriFlux data archive at the Carbon Dioxide Information Analysis Center (CDIAC) at: http://cdiac.esd.ornl.gov/programs/ameriflux/data2.htm.

Eddy Covariance Instrumentation and Measurements

The eddy covariance systems were deployed over the following dates:

Happy Valley: 11 June-30 August, 1994 and 30 May-6 September, 1995.

U-Pad: 3 June-31 August, 1994 and 29 May-16 September, 1995.

24-Mile: 16 June-31 August, 1995.

Barrow: 1 July-31 October, 1998 and 1 June-31 August, 1999.

Atqasuk: 1 June-29 October, 1999.

For the Barrow and Atqasuk sites, the eddy correlation measurement system provides *in situ* 10Hz data of CO_2, H_2O, sensible heat and latent heat fluxes using a three-dimensional Gill (R3) ultrasonic anemometer/thermometer with an open-path CO_2/H_2O (NOAA-ATDD) infrared analyzer. These 10Hz data are then averaged every 30minutes to obtain half-hourly flux estimates of mass, momentum and energy. Additional, meteorological variables such as net radiation, photosynthetically active radiation (PAR), ground heat flux, air temperature, relative humidity, soil temperature and precipitation are measured and stored as 30-min averages (precipitation as accumulated half hour totals).

For the Happy Valley, U-Pad, and 24-Mile sites, fluctuations in wind speed and temperature were measured at 10 Hz using a tri-axial sonic anemometer-thermometer (SWS-211/3K, Applied Technologies Inc., Boulder, CO) with a path length of 15 cm. The sensors were mounted at a height of 2.5 m above ground level (Happy Valley and U-Pad) and 3.5 m above ground level (24-Mile) and physically aligned toward the predominant wind direction. Carbon dioxide and H_2O vapor fluctuations were measured at 10 Hz using a closed path infrared gas analyzer equipped with a pressure transducer (LI-6262, LI-COR, Inc., Lincoln, NE). Flow rate through the 3 mm diameter by 3 m long plastic inlet tubing was measured using a rotameter, and maintained at 9-10 L min^{-1} using either a carbon vane or diaphragm pump installed with a 12 VDC continuous power supply to maintain a consistent pump speed and flow rate. Sample air was under vacuum in the gas analyzer, and mechanical pulses from the pump were dampened using a 2 L baffle attached between the vacuum pump and the gas analyzer. The gas sample inlet was located 13 cm behind the vertical sample path of the sonic anemometer. In addition to the closed-path analyzer, an open-path CO_2 and H_2O vapor infrared gas analyzer, mounted 25 cm behind the vertical

sample path of the sonic anemometer, was used during the 1995 field season for redundancy in the CO_2 and H_2O vapor measurements. This sensor has a response time of 10 Hz and a sensitivity of 6.8 µmol m^{-3} and 0.5 mmol m^{-3} to CO_2, and H_2O vapor, respectively. The CO_2 and H_2O vapor channels of both analyzers were calibrated every other week using a 300 and 400 ppm standard gas and a portable dew-point generator (LI-610, LI-COR, Inc. Lincoln, NE), respectively. The drift in the CO_2 and H_2O vapor calibration coefficients for both sensors over the growing season was $\pm$ 0.1 mmol m^{-3} and $\pm$ 0.2 mol m^{-3}, respectively.

Raw CO_2 and H_2O vapor fluctuations were output as mean voltages and converted to densities by multiplying by the requisite calibration constants. Net CO_2, H_2O vapor, and sensible heat fluxes were computed following a coordinate rotation of the wind vectors, and fast response (10 Hz) fluxes were calculated and stored on a laptop computer as 30-minute averages using a 200 s running mean and digital recursive filtering technique. Closed-path CO_2 flux estimates were corrected for the simultaneous flux of H_2O vapor. Open-path flux estimates were corrected for the simultaneous fluctuations in both heat and H_2O vapor, as the fluctuations in both CO_2 and H_2O vapor were measured *in situ*.

Meteorological Instrumentation

Meteorological conditions were measured every 60 s between 11 June-30 August and 30 May-6 September in 1994 and 1995, respectively, and stored as 30 minute averages using a datalogger (CR 21X, Campbell Scientific, Inc. Ogden, UT). Wet- and dry-bulb temperatures were measured at 25, 100, and 200 cm above ground level using ventilated psychrometers affixed with cross-calibrated type-t thermocouples. Soil temperatures were measured between 0-80 cm below the moss surface at 5 cm increments using cross calibrated type-t thermocouples. Net radiation (R_n) was measured at a height of 1 m using a net radiometer (Q-6, REBS, Seattle, WA). Soil heat flux (G) was measured using two soil heat flux plates (HFT-1, REBS, Seattle, WA) buried 2 cm below the moss surface. Because of the high heat capacity of the moss layer, G was corrected by adding heat flux in the moss layer above the heat flux plates. Photosynthetic photon flux density (PPFD) was measured using a quantum sensor (LI-190SB, LI-COR, Inc. Lincoln, NE). Summer precipitation (1 June-31 August) was measured in 1995 using a tipping-bucket rainfall gauge (2501, Sierra-Misco, Inc., Berkeley, CA).

File Formats and Data Descriptions

Happy Valley 1994.
69°08.54'N, 148°50.47'W

Vegetation type (Auerbach and Walker, 1995): Moist-acidic tundra
Elevation: 365.55 m MSL
Vegetation cover and data: Should be obtained from Skip Walker

File Name: H94.txt
File Type: Tab-delimited ascii text.
File Contents/Column Headers
Day
Time: (AK daylight time)
20 cm T: Air temperature at 20 cm above ground level (AGL) (°C)
10 cm T: Air temperature at 10 cm AGL (°C)
8 cm T: Air temperature at 8 cm AGL (°C)
5 cm T: Air temperature at 5 cm AGL (°C)
0 cm T: Temperature at the "soil surface" (°C)
(5) cm T: Soil temperature at 5 cm below ground level (BGL) (°C)
(10) cm T: Soil temperature at 10 cm BGL (°C)
(15) cm T: Soil temperature at 15 cm BGL (°C)
(20) cm T: Soil temperature at 20 cm BGL (°C)
(25) cm T: Soil temperature at 25 cm BGL (°C)
(30) cm T: Soil temperature at 30 cm BGL (°C)
(35) cm T: Soil temperature at 35 cm BGL (°C)
(40) cm T: Soil temperature at 40 cm BGL (°C)
(50) cm T: Soil temperature at 50 cm BGL (°C)
(60) cm T: Soil temperature at 60 cm BGL (°C)
(70) cm T: Soil temperature at 70 cm BGL (°C)
20 cm WT: Wet-bulb air temperature at 20 cm AGL (°C)
20 cm DT: Dry-bulb air temperature at 20 cm AGL (°C)
50 cm WT: Wet-bulb air temperature at 50 cm AGL (°C)
50 cm DT: Dry-bulb air temperature at 50 cm AGL (°C)
100 cm WT: Wet-bulb air temperature at 100 cm AGL (°C)
100 cm DT: Dry-bulb air temperature at 100 cm AGL (°C)
200 cm WT: Wet-bulb air temperature at 200 cm AGL (°C)
200 cm DT: Dry-bulb air temperature at 200 cm AGL (°C)
PAR: Photosynthetic photon flux density (Quantum flux) (µmol m-2 s-1 or µE m-2 s-1)
Rnet: Net radiation (W/m2)
Rsolar: Incomming solar radiation (W/m2)
G1: Ground heat flux from heat flux plate 1 (W/m2)
G2: Ground heat flux from heat flux plate 2 (W/m2)
Ave. G: Average ground heat flux (W/m2)

Corr. G: Corrected ground heat flux (W/m2)
WS 20 cm: Wind speed at 20 cm AGL (m/s)
WS 50 cm: Wind speed at 50 cm AGL (m/s)
WS 100 cm: Wind speed at 100 cm AGL (m/s)
WS 200 cm: Wind speed at 200 cm AGL (m/s)
Direction: Wind direction (deg.)
SD W. Dir.: Standard deviation in wind direction over 30 minute averaging period (deg.)
u*: Frictional velocity (m/s)
Corr.H: Sensible heat flux (W/m2)
WPL w'E': Evapotranspiration (mg H2O/m2/s)
Le: Latent heat flux (W/m2)
WPL w'C': CO2 flux (gC m-2 hr-1)

** -6999 = sensor not working

Happy Valley 1995
69°08.54'N, 148°50.47'W
Vegetation type (Auerbach and Walker, 1995): Moist-acidic tundra
Elevation: 365.55 m MSL
Vegetation cover and data: Should be obtained from Skip Walker

File Name: H95.txt
File Type: Tab-delimited ascii text.
File Contents/Column Headers
Day
Time: (AK daylight time)
20 cm T: Air temperature at 20 cm above ground level (AGL) (°C)
10 cm T: Air temperature at 10 cm AGL (°C)
8 cm T: Air temperature at 8 cm AGL (°C)
5 cm T: Air temperature at 5 cm AGL (°C)
0 cm T: Temperature at the "soil surface" (°C)
(5) cm T: Soil temperature at 5 cm below ground level (BGL) (°C)
(10) cm T: Soil temperature at 10 cm BGL (°C)
(15) cm T: Soil temperature at 15 cm BGL (°C)
(20) cm T: Soil temperature at 20 cm BGL (°C)
(25) cm T: Soil temperature at 25 cm BGL (°C)
(30) cm T: Soil temperature at 30 cm BGL (°C)
(35) cm T: Soil temperature at 35 cm BGL (°C)

(40) cm T: Soil temperature at 40 cm BGL (°C)
(50) cm T: Soil temperature at 50 cm BGL (°C)
(60) cm T: Soil temperature at 60 cm BGL (°C)
(70) cm T: Soil temperature at 70 cm BGL (°C)
25 cm WT: Wet-bulb air temperature at 25 cm AGL (°C)
25 cm DT: Dry-bulb air temperature at 25 cm AGL (°C)
100 cm WT: Wet-bulb air temperature at 100 cm AGL (°C)
100 cm DT: Dry-bulb air temperature at 100 cm AGL (°C)
200 cm WT: Wet-bulb air temperature at 200 cm AGL (°C)
200 cm DT: Dry-bulb air temperature at 200 cm AGL (°C)
PAR: Photosynthetic photon flux density (Quantum flux) (µmol m-2 s-1 or µE m-2 s-1)
Rnet: Net radiation (W/m2)
Rsolar: Incomming solar radiation (W/m2)
G1: Ground heat flux from heat flux plate 1 (W/m2)
G2: Ground heat flux from heat flux plate 2 (W/m2)
Ave. G: Average ground heat flux (W/m2)
Corr. G: Corrected ground heat flux (W/m2)
WS 50 cm: Wind speed at 25 cm AGL (m/s)
WS 100 cm: Wind speed at 100 cm AGL (m/s)
WS 210 cm: Wind speed at 200 cm AGL (m/s)
Direction: Wind direction (deg.)
SD W. Dir.: Standard deviation in wind direction over 30 minute averaging period (deg.)
PPT: Precipitation (mm)
u*: Frictional velocity (m/s)
Corr.H: Sensible heat flux (W/m2)
WPL w'E': Evapotranspiration (mg H2O/m2/s)
Le: Latent heat flux (W/m2)
WPL w'C': CO2 flux (gC m-2 hr-1)

** -6999 = sensor not working

U-Pad 1994 (aka Pingo Betty)
70°16.88'N, 148°53.23'W
Vegetation type (Auerbach and Walker, 1995): Moist-wet sedge tundra
Elevation: ca. 5 m MSL
Vegetation cover and data: Should be obtained from Skip Walker

File Name: U94.txt
File Type: Tab-delimited ascii text.

File Contents/Column Headers

Day

Time: (AK daylight time)

20 cm T: Air temperature at 20 cm above ground level (AGL) (°C)

10 cm T: Air temperature at 10 cm AGL (°C)

8 cm T: Air temperature at 8 cm AGL (°C)

5 cm T: Air temperature at 5 cm AGL (°C)

0 cm T: Temperature at the "soil surface" (°C)

(5) cm T: Soil temperature at 5 cm below ground level (BGL) (°C)

(10) cm T: Soil temperature at 10 cm BGL (°C)

(15) cm T: Soil temperature at 15 cm BGL (°C)

(20) cm T: Soil temperature at 20 cm BGL (°C)

(25) cm T: Soil temperature at 25 cm BGL (°C)

(30) cm T: Soil temperature at 30 cm BGL (°C)

(35) cm T: Soil temperature at 35 cm BGL (°C)

(40) cm T: Soil temperature at 40 cm BGL (°C)

(50) cm T: Soil temperature at 50 cm BGL (°C)

(60) cm T: Soil temperature at 60 cm BGL (°C)

(70) cm T: Soil temperature at 70 cm BGL (°C)

20 cm WT: Wet-bulb air temperature at 20 cm AGL (°C)

20 cm DT: Dry-bulb air temperature at 20 cm AGL (°C)

50 cm WT: Wet-bulb air temperature at 50 cm AGL (°C)

50 cm DT: Dry-bulb air temperature at 50 cm AGL (°C)

100 cm WT: Wet-bulb air temperature at 100 cm AGL (°C)

100 cm DT: Dry-bulb air temperature at 100 cm AGL (°C)

200 cm WT: Wet-bulb air temperature at 200 cm AGL (°C)

200 cm DT: Dry-bulb air temperature at 200 cm AGL (°C)

PAR: Photosynthetic photon flux density (Quantum flux) (µmol m-2 s-1 or µE m-2 s-1)

Rnet: Net radiation (W/m2)

Rsolar: Incomming solar radiation (W/m2)

G1: Ground heat flux from heat flux plate 1 (W/m2)

G2: Ground heat flux from heat flux plate 2 (W/m2)

Ave. G: Average ground heat flux (W/m2)

Corr. G: Corrected ground heat flux (W/m2)

WS 20 cm: Wind speed at 20 cm AGL (m/s)

WS 50 cm: Wind speed at 50 cm AGL (m/s)

WS 100 cm: Wind speed at 100 cm AGL (m/s)

WS 200 cm: Wind speed at 200 cm AGL (m/s)

Direction: Wind direction (deg.)

SD W. Dir.: Standard deviation in wind direction over 30 minute averaging period (deg.)
u*: Frictional velocity (m/s)
Corr.H: Sensible heat flux (W/m2)
WPL w'E': Evapotranspiration (mg H2O/m2/s)
Le: Latent heat flux (W/m2)
WPL w'C': CO2 flux (gC m-2 hr-1)

** -6999 = sensor not working

U-Pad 1995 (aka Pingo Betty)
70°16.88'N, 148°53.23'W
Vegetation type (Auerbach and Walker, 1995): Moist-wet sedge tundra
Elevation: ca. 5 m MSL
Vegetation cover and data: Should be obtained from Skip Walker

File Name: U95.txt
File Type: Tab-delimited ascii text.
File Contents/Column Headers
Day
Time: (AK daylight time)
20 cm T: Air temperature at 20 cm above ground level (AGL) (°C)
10 cm T: Air temperature at 10 cm AGL (°C)
8 cm T: Air temperature at 8 cm AGL (°C)
5 cm T: Air temperature at 5 cm AGL (°C)
0 cm T: Temperature at the "soil surface" (°C)
(5) cm T: Soil temperature at 5 cm below ground level (BGL) (°C)
(10) cm T: Soil temperature at 10 cm BGL (°C)
(15) cm T: Soil temperature at 15 cm BGL (°C)
(20) cm T: Soil temperature at 20 cm BGL (°C)
(25) cm T: Soil temperature at 25 cm BGL (°C)
(30) cm T: Soil temperature at 30 cm BGL (°C)
(35) cm T: Soil temperature at 35 cm BGL (°C)
(40) cm T: Soil temperature at 40 cm BGL (°C)
(50) cm T: Soil temperature at 50 cm BGL (°C)
(60) cm T: Soil temperature at 60 cm BGL (°C)
(70) cm T: Soil temperature at 70 cm BGL (°C)
25 cm WT: Wet-bulb air temperature at 25 cm AGL (°C)
25 cm DT: Dry-bulb air temperature at 25 cm AGL (°C)
100 cm WT: Wet-bulb air temperature at 100 cm AGL (°C)

100 cm DT: Dry-bulb air temperature at 100 cm AGL (°C)
200 cm WT: Wet-bulb air temperature at 200 cm AGL (°C)
200 cm DT: Dry-bulb air temperature at 200 cm AGL (°C)
PAR: Photosynthetic photon flux density (Quantum flux) (µmol m-2 s-1 or µE m-2 s-1)
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Rsolar: Incomming solar radiation (W/m2)
G1: Ground heat flux from heat flux plate 1 (W/m2)
G2: Ground heat flux from heat flux plate 2 (W/m2)
Ave. G: Average ground heat flux (W/m2)
Corr. G: Corrected ground heat flux (W/m2)
WS 25 cm: Wind speed at 25 cm AGL (m/s)
WS 100 cm: Wind speed at 100 cm AGL (m/s)
WS 200 cm: Wind speed at 200 cm AGL (m/s)
Direction: Wind direction (deg.)
SD W. Dir.: Standard deviation in wind direction over 30 minute averaging period (deg.)
PPT: Precipitation (mm)
u*: Frictional velocity (m/s)
Corr.H: Sensible heat flux (W/m2)
WPL w'E': Evapotranspiration (mg H2O/m2/s)
Le: Latent heat flux (W/m2)
WPL w'C': CO2 flux (gC m-2 hr-1)

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24-Mile 1995
69°56.102'N, 148°48.616'W
Vegetation type (Auerbach and Walker, 1995): Moist non-acidic tundra
Elevation: 85 m MSL
Vegetation cover and data: Should be obtained from Skip Walker

File Name: M95.txt
File Type: Tab-delimited ascii text.
File Contents/Column Headers
Day
Time: (AK daylight time)
Rnet: Net radiation (W/m2)
PAR: Photosynthetic photon flux density (Quantum flux) (µmol m-2 s-1 or µE m-2 s-1)
Ave. G: Average ground heat flux (W/m2)
W. Direction: Wind direction (deg.)

Corr.WD: Actual wind direction (deg)
Ave. u: Average wind speed at 3.5 m AGL (m/s)
u*: Frictional velocity (m/s)
Air T°: Air temperature at 3.5 m AGL (°C)
Corr.H: Sensible heat flux (W/m2)
WPL w'E': Evapotranspiration (mg H2O/m2/s)
Le: Latent heat flux (W/m2)
WPL w'C': CO2 flux (gC m-2 hr-1)

** -6999 = sensor not working

Barrow 1998, 1999, 2000, 2001
71°21'00.00"N, 156°37'18.53"W
File Names: AK_BRW_98.txt, AK_BRW_99.txt, AK_BRW_2000.txt, AK_BRW_2001.txt
File Type: Comma-delimited ascii text.

File Contents/Column Headers

Missing values are represented by "-9999". No data collected are represented by “N/A”.

Disclaimer:

Data processed in 1999 have to be considered preliminary and these estimates could change considerably and without notice. Use of these data should be coordinated with the project investigators, and they reserve the right to co-authorship if deemed appropriate.

Symbol	Description	Instrument	Unit
YY	Year		
JD	Julian Day		
TM	Time		
Rn	Net Radiation	Q-7 (REBS)	W m^{-2}
LE	Latent Heat Flux	ATDD/NOAA Open-Path IRGA	W m^{-2}
H	Sensible Heat Flux	Sonic Anemometer (Gill inc)	W m^{-2}
G_1	Soil Heat Flux	HFT-3 (REBS)	W m^{-2}
G_2	Soil Heat Flux	HFT-3 (REBS)	W m^{-2}
PAR	Photosynthetically Active Radiation	LI-190SB (LI-COR)	μE m^{-2} s^{-1}
Air T	Air Temperature at	HMP 35C (Vaisala)	^{o}C
Soil T1_0	Soil temperature at 0 cm	Type-T Thermocouple	^{o}C
Soil T1_5	Soil temperature at –5 cm	Type-T Thermocouple	^{o}C
SoilT1_10	Soil temperature at –10cm	Type-T Thermocouple	^{o}C
Soil T2_0	Soil temperature at 0 cm	Type-T Thermocouple	^{o}C
Soil T2_5	Soil temperature at –5 cm	Type-T Thermocouple	^{o}C
SoilT2_10	Soil temperature at –10cm	Type-T Thermocouple	^{o}C
RH	Relative Humidity	HMP 35C (Vaisala)	%
Rain	Precipitation	TE525 (Texas Electronics)	mm
WD	Wind Direction	Sonic Anemometer (Gill Inc.)	^{o} (True)
WS	Wind Speed	Sonic Anemometer (Gill Inc.)	m s^{-1}
u*	Friction Velocity	Sonic Anemometer (Gill Inc.)	m s^{-1}
FCO2	CO2 Flux	ATDD/NOAA Open-Path IRGA	mg m^{-2} s^{-1}
FH2O	H2O Flux	ATDD/NOAA Open-Path IRGA	mg m^{-2} s^{-1}

8. Atqasuk 1999, 2000, 2001

70°28'10.6"N, 157°24'32.2"W
File Names: AK_ATQ_99.txt, AK_ATQ_2000.txt, AK_ATQ_2001.txt
File Type: Comma-delimited ascii text.
File Contents/Column Headers

Symbol	Description	Instrument	Unit
YY	Year		
JD	Julian Day		
TM	Time		
Rn	Net Radiation	Q-7 (REBS)	W m^{-2}
LE	Latent Heat Flux	ATDD/NOAA Open-Path IRGA	W m^{-2}
H	Sensible Heat Flux	Sonic Anemometer (Gill inc)	W m^{-2}
G_1	Soil Heat Flux	HFT-3 (REBS)	W m^{-2}
G_2	Soil Heat Flux	HFT-3 (REBS)	W m^{-2}
PAR	Photosynthetically Active Radiation	LI-190SB (LI-COR)	μE m^{-2} s^{-1}
Air T	Air Temperature at	HMP 35C (Vaisala)	^{o}C
Soil T1_0	Soil temperature at 0 cm	Type-T Thermocouple	^{o}C
Soil T1_5	Soil temperature at –5 cm	Type-T Thermocouple	^{o}C
SoilT1_10	Soil temperature at –10cm	Type-T Thermocouple	^{o}C
Soil T2_0	Soil temperature at 0 cm	Type-T Thermocouple	^{o}C
Soil T2_5	Soil temperature at –5 cm	Type-T Thermocouple	^{o}C
SoilT2_10	Soil temperature at –10cm	Type-T Thermocouple	^{o}C
RH	Relative Humidity	HMP 35C (Vaisala)	%
Rain	Precipitation	TE525 (Texas Electronics)	mm
WD	Wind Direction	Sonic Anemometer (Gill Inc.)	^{o} (True)
WS	Wind Speed	Sonic Anemometer (Gill Inc.)	m s^{-1}
u*	Friction Velocity	Sonic Anemometer (Gill Inc.)	m s^{-1}
FCO2	CO2 Flux	ATDD/NOAA Open-Path IRGA	mg m^{-2} s^{-1}
FH2O	H2O Flux	ATDD/NOAA Open-Path IRGA	mg m^{-2} s^{-1}

Missing values are represented by "-9999". No data collected are represented by “N/A”.

Disclaimer:

Data processed in 1999 have to be considered preliminary and these estimates could change considerably and without notice. Use of these data should be coordinated with the project investigators, and they reserve the right to co-authorship if deemed appropriate.

Citations for Data

Auerbach NA and Walker DA. (1995) Unpublished map. See also Muller SV, Walker DA, Nelson FE, Auerbach NA, Bockheim JG, Guyer S, and Sherba D. (1998) Accuracy assessment of a land-cover map of the Kuparuk river basin, Alaska: Considerations for remote regions. Photogrammetric Engineering & Remote Sensing 64: 619-628.

Vourlitis GL and Oechel WC. (1999) Eddy covariance measurements of net CO_2 flux and energy balance of an Alaskan moist-tussock tundra ecosystem. Ecology 80: 686-701.

Vourlitis GL and Oechel WC (1997) Landscape-scale CO_2, H_2O vapor, and energy flux of moist-wet coastal tundra ecosystems over two growing-seasons. Journal of Ecology 85: 575-590.

Vourlitis GL (1997) Large-scale measurements of net CO_2 flux and energy balance of Alaskan arctic tundra ecosystems. PhD Dissertation, San Diego State University and the University of California, Davis. 146 Pages.